

Observations, &c. (*continued*).

Glasgow:—Mitchell Library. Report. 1887. 8vo. *Glasgow* 1888.  
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Guatemala:—Dirección General de Estadística. Informe. 1887.  
8vo. *Guatemala* 1888. The Office.

India:—Geological Survey. Memoirs (*Palæontologia Indica*.)  
Ser. 13. Vol. I. Part 7. 4to. *Calcutta* 1887.

The Survey.

June 21, 1888.

Professor G. G. STOKES, D.C.L., President, in the Chair.

An Address to the Queen, expressing sympathy with Her Majesty and with her daughter, the Empress of Germany, on the death of the Emperor, was read from the Chair.

Colonel Alexander Ross Clarke, Professor Alfred George Greenhill, and Professor John Henry Poynting were admitted into the Society.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read:—

- I. "Further Researches on the Physiology of the Invertebrata." By A. B. GRIFFITHS, Ph.D., F.R.S. (Edin.), F.C.S. (Lond. and Paris), Principal and Lecturer on Chemistry and Biology, School of Science, Lincoln; Member of the Physico-Chemical Society of St. Petersburg. Communicated by SIR RICHARD OWEN, K.C.B., F.R.S. Received May 25, 1888.

I. *The Renal Organs of the Asteridea.*

The digestive apparatus of *Uraster rubens* (one of the Asteridea) is briefly described as follows:—The capacious mouth, found upon the under side, leads into a short œsophagus, which opens into a wider sacculated stomach with thin distensible walls. There are five large stomach sacs; each of these is situated in a radial position and passes into the base of the corresponding ray. Each sac or pouch is kept in its place by two retractor muscles fixed to the median ridge of the ray, which lie between the two ampullæ or water-sacs. Passing

towards the aboral side, the stomach forms the well-known pentagonal "pyloric sac." The pyloric sac gives off five radial ducts, each of which divides into two tubules bearing a number of lateral follicles, whose secretions are poured into the pyloric sac and intestine. The author has proved the nature of their secretion to be similar to that of the pancreatic fluid of the Vertebrata ('Edinburgh, Roy. Soc. Proc.,' No. 125, p. 120). Recently, the secretion found in the five pouches of the stomach (of *Uraster*) has been submitted to a careful chemical and microscopical examination. With a quantity of the secretion, obtained from a large number of starfishes, the following experiments were performed:—

1. The clear liquid from these sacs was treated with a hot dilute solution of sodium hydrate. On the addition of pure hydrochloric acid, a slight flaky precipitate was obtained, after standing seven and a half hours. These flakes when examined beneath the microscope ( $\frac{1}{6}$ -in. obj.) were seen to consist of various crystalline forms, the predominant forms being those of the rhomb. On treating the secretion alone with alcohol rhombic crystals are deposited, which are soluble in water. When these crystals are treated with nitric acid and then gently heated with ammonia, reddish-purple murexide is obtained, crystallised in microscopic prisms.

2. Another method was used for testing the secretion. It (the secretion) was boiled in distilled water and evaporated carefully to dryness. The residue obtained was treated with absolute alcohol and filtered. Boiling water was poured upon the residue, and to the aqueous filtrate an excess of acetic acid was added. After standing some hours, crystals of *uric acid* were deposited and easily recognised by the chemico-microscopical tests mentioned above.

The above alcoholic filtrate was tested for *urea*. First of all, the alcoholic solution was diluted with distilled water, and boiled over a water-bath until all the alcohol had vaporised. The warm aqueous solution (A) remaining was now tested for urea, in the following manner:—

- (a.) On the addition of a solution of mercuric nitrate to a portion of the above solution, *no* white precipitate was obtained.
- (b.) To another portion of the solution (A), a solution of sodium hypochlorite was added. No bubbles of nitrogen were disengaged.
- (c.) No crystals of urea nitrate were formed in a small quantity of the solution (A) [concentrated by evaporation] after the addition of nitric acid.
- (d.) The distillation of a small quantity of the solution (A) with pure sodium carbonate, in a chemically clean Wurtz's flask attached to a small Liebig's condenser, failed to produce in the distillate any coloration with Nessler's reagent.

The above tests clearly prove the entire absence of urea in the secretion under examination. No guanin or calcium phosphate could be detected in the secretion, although the author has found the latter compound as an ingredient in the renal secretions of the Cephalopoda and the Lamellibranchiata ('Edinburgh, Roy. Soc. Proc.,' vol. 14, p. 230).

From this investigation, the isolation of uric acid proves the renal function of the five pouches of the stomach of the Asteridea.

## II. The Salivary Glands of *Sepia officinalis* and *Patella vulgata*.

The author has already made a study of the nephridia and the so-called "livers" in both these forms of the Invertebrata (see the memoirs, *loc. cit.*). Since then he has studied the chemico-physiological reactions of the secretion produced by the salivary glands of the cuttle-fish and the limpet, these organisms representing two important orders of the Mollusca.

### (1.) *Sepia officinalis*.

There are two pairs of salivary glands in *Sepia officinalis*. The posterior pair, which are the largest, lie on either side of the oesophagus. The secretion of the posterior glands is poured into the oesophagus, while the secretion of the smaller anterior pair of glands passes directly into the buccal cavity. A quantity of the secretion was extracted by using several freshly killed cuttle-fishes. It was alkaline to test-papers. A portion of the secretion was added to a small quantity of starch, the starch being converted into glucose sugar in 15 minutes. The presence of glucose was proved by the formation of red cuprous oxide by the action of Fehling's solution. The soluble zymase (ferment) contained in the secretion (which is capable of causing the hydration of starch), was isolated by precipitating the secretion with dilute normal phosphoric acid, adding lime-water and then filtering. The precipitate produced was dissolved in distilled water and reprecipitated by alcohol. This precipitate converts starch into glucose sugar.

When a drop of the clear secretion is allowed to fall into a beaker containing dilute acetic acid, stringy flakes of *mucin* are easily obtained. The presence of mucin was confirmed by several well-known tests.

Another portion of the secretion was distilled (with the utmost care) with dilute sulphuric acid, and to the distillate ferric chloride solution was added, which gave a red colour, indicating the presence of sulphocyanates.

The inorganic constituent, as far as the author could make out,

consists only of phosphate of calcium. No calcium carbonate could be detected.

There is much in favour of the supposition that the *diastatic ferment* in these secretions is produced as the result of the action of nerve-fibres (from the inferior buccal ganglion) upon the protoplasm of the epithelium cells of the glands.

The author intends to examine various organs in other genera and species of the Decapoda, especially those inhabiting the Japanese seas.

(2.) *Patella vulgata*.

The two salivary glands of *Patella* are well-marked and situated anteriorly to the pharynx, lying beneath the pericardium on one side and the renal and anal papillæ on the other. They are of a yellowish-brown colour and give off four ducts. The secretion of these glands was examined by the same method applied to the salivary glands of *Sepia officinalis*, and with similar results.

The following table represents the constituents found in the salivary secretions of the two orders of the Mollusca already investigated:—

	Cephalopoda.	Gasteropoda.	
	(a.) Dibranchiata.	(a.) Pulmogasteropoda.*	(b.) Branchiogasteropoda.
Soluble diastatic ferment . . . . .	present	present	present
Mucin . . . . .	present	..	present
Sulphocyanates . . .	present	?	present
Calcium phosphate.	present	?	present

Investigations indicate that the salivary glands of the Cephalopoda and Gasteropoda are similar in physiological function to the salivary glands of the Vertebrata.

\* 'Edinburgh, Roy. Soc. Proc.,' vol. 14, p. 236.